Ollscoil na hÉireann, Gaillimh
National University of Ireland, Galway

Autumn Examinations, 2012/2013

Exam Code(s)	4IF
Exam(s)	4th Year Examination in BSc in IT
Module Code(s)	CT421
Module(s)	Artificial Intelligence
Repeat Paper	
External Examiner(s)	Professor M. O'Boyle
Internal Examiner(s)	*Dr M Madden *Dr Conn Mulvihill *Dr. F. S. Smith

Instructions: Attempt 2 questions from Section A, 1 from Section B and 1 from Section C. Answer each section in a separate answer book.

Duration	**3 hours**
No. of Pages	5
Department(s)	Information Technology

Section A

Answer 2 questions from this section.

1)

a) Write the following Prolog predicates:

i) capped(List, Capped). Where List is a list of integers and Capped is the same list except all of its elements have been capped at the value 10.

For example:

capped([1,2,3,13,5,20],X).

would give the answer:

X = [1,2,3,10,5,10]

(5 marks)

ii) removepairs(List,Result). Where List is a list of elements and Result is the same list but with all consecutive duplicates removed.

For Example:

Removepairs([1,1,2,3,3,1,4,4],X).

would give the answer:

X = [1,2,3,1,4]

(11 marks)

b) How does Prolog handle the concept of type? Is it possible to explicitly declare a variable in Prolog?

(9 marks)

2)

a) Write a predicate 'samelength' that takes two arguments. The predicate should return true if both of the arguments are lists with the same number of elements.

(12 marks)

b) Write a predicate 'average' that takes 3 arguments. The predicate should return true if the value of the 3rd argument is the average of the first and second arguments. For example:
(13 marks)

3)

a) Explain what is meant by Fuzzy Logic. How can it be applied to classification systems?

(9 marks)

b) What are the differences between forward and backward chaining – what conditions would you need to choose each of them?

(7 marks)

c) How does AI search differ from conventional search?
Describe Heuristic search, highlighting the advantages and disadvantages associated with it.

(9 marks)

Section B

Answer 1 question from this section.

4)

(a) Machine Learning techniques can be categorised according to whether they are *supervised*, *unsupervised*, *semi-supervised*, or *reward-based*. Explain each of those four terms, provide examples of the tasks that are in each category, and examples of one technique that is appropriate for tackling each task. (8 marks)

(b) How does Data Mining relate to Machine Learning? Explain the main stages in the data mining process. (5 marks)

(c) Explain the operation of the basic k-Nearest Neighbours algorithm, demonstrating how it can be used for both classification and regression. (4 marks)

(d) A colleague who is developing a game AI has made some progress using kNN, but has encountered two problems with the basic algorithm: (1) Some attributes are on different scales than others (e.g. health is in range 0-1, gold is in range 1-1000); (2) she has a large number of attributes, and some may be more significant than others. Provide some advice on dealing with these two issues. (8 marks)

5)

(a) Explain, with examples, the distinction between **conditional** independence and **absolute** independence. How are each of these represented in a Bayesian network? (5 marks)

(b) Bayesian networks can be used for both data exploration and classification. Explain this. (5 marks)

(c) In the context of Linear Support Vector Machines, describe why the "kernel trick" is needed and how it works. (5 marks)

(d) A company is working on a social media site based on sharing photos with short captions, and wishes to automatically identify postings that are spam from the caption text. They have the following small set of captions that are spam and OK:

Spam:	*OK:*
"click this link"	"cat sleeping today"
"weight drugs link"	"good sleeping"
"drugs news here"	"good luck cat"
	"news meeting today"

Using a Naïve Bayes classifier, compute the probability of the following two messages being spam: (1) "drugs news link"; (2) "cat news". Show all steps in your computation and explain any assumptions you make. (10 marks)

Section C

Answer 1 question from this section.

6)

a) What is your understanding of the term 'intelligent agent'?
(5 marks)

b) 'Intelligent agents are capable of engaging in covert communications'.
Develop any one example of your own devising that illustrates this statement.
(10 marks)

c) Watson, the IBM system that appeared on the game show 'Jeopardy!',
is being deployed in cancer treatment and health insurance. Is Watson the future for intelligent agents in your view?
(10 marks)

7)

a) In the context of genetic algorithms, explain the term 'mutation'.
(5 marks)

b) Consider a genetic algorithm that is built for the travelling salesman problem. With a positive integer representation for cities, discuss any one issue in connection with this representation that may arise in mutation and crossover. You may, for explanatory purposes, assume that all the cites are on the circumference of a circle, and that there are exactly ten cities.
(10 marks)

c) Develop a genetic algorithm for navigation in a two dimensional maze. You may assume that the entrance to the maze is in the south-east corner and that the exit from the maze is in the north-west corner.
(10 marks)